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FOREST INVENTORY STATISTICS
YAKUTAT WORKING CIRCLE
NORTH TONGASS NATIONAL FOREST

Forest Survey Report No. 4
by
A. P. Caporaso

(In-Service Use Only)

Forest Service
U. S. Department of Agriculture

Alaska Forest Research Center

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CONTENTS

Page

FOREWORD..... 1

HIGHLIGHTS
Area..... 2
Timber volume..... 3

STATISTICAL TABLES
Table 1.--Land area by major land classes and timber management block..... 5

Table 2.--Area of commercial forest land by ownership class and block..... 6

Table 3.--Net volume of live sawtimber on commercial forest land by ownership class and block..... 6

Table 4.--Area of National Forest commercial forest land by block and land type..... 7

Table 5.--Net volume of live sawtimber on National Forest commercial forest land by block and land type..... 7

Table 6.--Area of National Forest commercial forest land by stand-size class and block..... 8

Table 7.--Net volume of live sawtimber on National Forest commercial forest land by stand-size class and block..... 9

Table 8.--Area of National Forest commercial forest land by forest type and block..... 10

Table 9.--Net board foot volume of live sawtimber on National Forest commercial forest land by species and block..... 11

Table 10a.--Net volume of all timber on accessible commercial forest land by class of material and species group, combined ownership..... 12

Table 10b.--Net volume of a ll timber on inaccessible commercial forest land by class of material and species group, combined ownership..... 13

Table 11.--Net board foot volume of live sawtimber on commercial forest land by species and diameter class groups, combined ownerships..... 14

CONTENTS (continued)

Page

Table 12.—Average net volume per acre in live merchantable trees on commercial forest land by land type and stand-size class..... 15

APPENDIX

Explanation of terms..... A-1
Species tallied..... A-4
Forest survey procedures
Area estimate..... A-4
Volume estimate..... A-6
Accuracy of estimates..... A-8
Coefficient of variation.....A-11
Table of Scribner to International $\frac{1}{4}$-inch ratios.....A-11
Average form class.....A-11

FOREWORD

This is the fourth in a series of reports on the forest area and timber volume of Southeast Alaska. It is a product of the Forest Survey of Southeast Alaska carried on by the Alaska Forest Research Center in cooperation with the Timber Management Division of Region 10 of the U. S. Forest Service.

The resource facts contained herein provide reliable data on a timber management working circle basis for the Region's long-range plans and formulation of policies for timber production and for their guidance of forest industry development. These facts are also additive to the nation-wide survey being conducted by the Forest Service's Division of Economics Research.

Funds for the conduct of the survey were supplied by both Region 10 and the Forest Survey. The aerial photos used were loaned by the Region. Field work was accomplished during the field season of 1957.

From initial planning to final compilation, these people worked on the inventory:

General Supervision:	A. P. Caporaso, Project Leader
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Photo Interpretation:	Paul Haack
Compilation:	Data Processing Unit, Pacific Southwest Forest and Range Experiment Station
Report:	A. P. Caporaso

Acknowledgement is also made of cooperation from personnel of the Regional Office and the Forest Supervisor's staff of the North Tongass National Forest.

HIGHLIGHTS

Area

Forest area

Only about 40 percent of the 795,900 acre Yakutat Working Circle is forested. However, about 88 percent of the 315,200 acres of forested land is commercial forest land. Due to present logging techniques, economic climate and topography in this area about 45,650 acres of the commercial forest land is presently inoperable. Young-growth stands, although not presently operable due to immaturity, when surrounded or adjacent to operable areas were classified as accessible or operable areas.

Ownership

The Yakutat Working Circle is characterized by almost complete Forest Service ownership of the commercial forest land area. About 200 acres of accessible commercial forest land is privately owned. There are, at present, no areas of reserved commercial forest.

Stand-size classes

Young-growth stands predominate in the Yakutat area. All of the inaccessible commercial forest land area and 62 percent of the accessible commercial forest area is in young growth stands.

Only 6 percent or about 2,700 acres of the inaccessible area contains young-growth sawtimber stands whereas 72 percent or about 32,900 acres is in the seedling-sapling stand-size class.

The accessible commercial forest land area has a relatively high proportion of seedling-sapling stands, about 25 percent or about 58,400 acres--second in area to the old-growth sawtimber stand-size class which occupies about 39 percent or 89,150 acres. Young-growth sawtimber stands rank third with 23 percent or 53,300 acres.

Forest types

The Yakutat Working Circle is predominately a Sitka spruce forest. This type comprises about 173,000 acres or about 63 percent of the total area. In the accessible area the Sitka Spruce type occupies about 72 percent of the area, but in the inaccessible zone it only makes up 16 percent of the area. The hardwood type ranks second with 30 percent or 82,750 acres. This is almost four times the combined area of hardwoods found in all other working circles on the Tongass Forests. In the inaccessible zone on the Yakutat Working Circle, the hardwood type occupies 84 percent of the area. Considerable areas of hardwood occur in Russell Fiord and in the broad delta region of the Alsek River.

Timber Volume

An estimated 4 billion board feet of merchantable National Forest timber or about 76 percent of the total net board foot volume is located in old-growth stands. All of the old-growth sawtimber is considered to be presently accessible and 75 percent of it is located in the Yakutat Block. There are, however, small, scattered old-growth stands of questionable economic value at the present time. These are sawtimber stands that net from 8 to 16 thousand board feet per acre.

Unlike other working circles on the Tongass, Yakutat has a substantial proportion of its volume in accessible, young-growth sawtimber stands. It is estimated at 1 billion board feet or about 20 percent of the total accessible board foot volume.

Only 3 species of commercial sawtimber-size were found in the Yakutat Working Circle. About 80 percent of the 5.2 billion board feet is in Sitka spruce followed by hemlock with 16 percent and cottonwood with 4 percent.

Almost 36 percent of the total board foot volume or 1.86 billion feet occurs in trees in the 21-inch to 30-inch diameter class group. Following in order is the 11- to 20-inch d.b.h. class with 30 percent of the board foot volume, thence the 31- to 40-inch d.b.h. class with 21 percent and finally the 41-inch and larger class group with 13 percent.

The average volume per acre for Yakutat old-growth sawtimber is considerably higher than those for other Tongass working circles. Yakutat averaged about 45 thousand b.f. per acre as compared to Juneau with 30 thousand, Sitka with 34 thousand, and Petersburg with 33 thousand.

Estimates of mortality and volume by log grades were not made due to the light sampling system. Estimates will be made at the Regional level to provide more reliable data.

Summary table of highlights, commercial forest land, Yakutat Working Circle, 1957

	Accessible		Inaccessible	
	Acres	Net volume	Acres	Net volume
Total growing stock	230,950	1,029,421 MCF	45,650	26,180 MCF
Total sawtimber volume 1/	230,950	892,187 MCF	45,650	21,337 MCF
National Forest				
Old-growth sawtimber	89,150	4,010,485 MBF	--	--
Young-growth sawtimber	24,700	1,014,870 MBF	2,700	102,984 MBF

1/ Includes only sawlog portion of the tree.

Percent of Board Foot Volume by Species

	Accessible	Inaccessible
Spruce	80.57	65.69
Hemlock	15.77	11.50
Cottonwood	3.66	22.81
	100.00	100.00

Table 1.--Land area by major land classes and timber management block, Yakutat Working Circle, 1957

Block	Forest Land 1/			Non-forest land 2/	Total
	Commercial accessible	Commercial inaccessible	Non-commercial		
	Acres	Acres	Acres	Acres	Acres
1. Yakutat	145,550	22,550	21,400	325,300	514,800
2. Dry Bay	85,400	23,100	17,200	155,400	281,100
Total	230,950	45,650	38,600	480,700	795,900
Percent of Total	29.02	5.73	4.85	60.40	100.00

1/ There are no areas of reserved commercial forest land in the Yakutat Working Circle.

2/ Includes 1,800 acres of water in areas from 10 to 40 acres that would be classified by the Bureau of Census as land but are classified as water according to Survey standards of area classification. Does not include tidewater.

Table 2.--Area of commercial forest land by ownership class and block, Yakutat Working Circle, 1957

Block	Ownership Class		Total
	National Forest	Private	
	Acres	Acres	Acres
1. Yakutat	167,900	200	168,100
2. Dry Bay	108,500	---	108,500
Total	276,400	200	276,600

Table 3.--Net volume of live sawtimber on commercial forest land by ownership class and block. Yakutat Working Circle, 1957

Block	Ownership Class		Total
	National Forest	Private	
	MBF Scribner	MBF Scribner	MBF Scribner
1. Yakutat	3,629,340	9,001	3,638,341
2. Dry Bay	1,593,410	---	1,593,410
Total	5,222,750	9,001	5,231,751

Table 4.--Area of National Forest commercial forest land by block and land type, Yakutat Working Circle, 1957

Block	Commercial Forest Land		Total
	Accessible	Inaccessible	
	Acres	Acres	Acres
1. Yakutat	145,350	22,550	167,900
2. Dry Bay	85,400	23,100	108,500
Total	230,750	45,650	276,400
Percent of total	83.48	16.52	100.00

Table 5.--Net volume of live sawtimber on National Forest commercial forest land by block and land type. Yakutak Working Circle, 1957

Block	Commercial Forest Land		Total
	Accessible	Inaccessible	
	MBF Scribner	MBF Scribner	MBF Scribner
1. Yakutat	3,591,635	37,705	3,629,340
2. Dry Bay	1,512,037	81,373	1,593,410
Total	5,103,672	119,078	5,222,750
Percent of Total	97.72	2.28	100.00

Table 6.--Area of National Forest commercial forest land by stand-size class and block, Yakutat Working Circle, 1957

Block	Stand-size Class					Total
	Old growth saw-timber (4)	Young growth saw-timber (3)	Pole-timber (2)	Seedlings & saplings (1)	Non-stocked (5)	
	Acres	Acres	Acres	Acres	Acres	Acres
Accessible						
1. Yakutat	66,950	28,600	12,900	36,900	--	145,350
2. Dry Bay	22,200	24,700	15,200	21,500	1,800	85,400
Total	89,150	53,300	28,100	58,400	1,800	230,750
Percent of Total	38.63	23.10	12.18	25.31	0.78	100.00
Inaccessible						
1. Yakutat	--	900	900	19,850	900	22,550
2. Dry Bay	--	1,800	2,750	13,050	5,500	23,100
Total	--	2,700	3,650	32,900	6,400	45,650
Percent of Total	--	5.91	8.00	72.07	14.02	100.00

Table 7.--Net volume of live sawtimber on National Forest commercial forest land by stand-size class and block, Yakutat Working Circle, 1957

Block	Stand-size Class					Total
	Old growth saw-timber (4)	Young growth saw-timber (3)	Pole-timber (2)	Seedlings & saplings (1)	Non-stocked (5)	
	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner
Accessible						
1. Yakutat	3,012,297	544,106	35,232	--	--	3,591,635
2. Dry Bay	998,188	470,764	41,332	--	1,753	1,512,037
Total	4,010,485	1,014,870	76,564	--	1,753	5,103,672
Percent of total	78.58	19.89	1.50	--	00.03	100.00
Inaccessible						
1. Yakutat	--	34,341	2,488	--	876	37,705
2. Dry Bay	--	68,643	7,472	--	5,258	81,373
Total	--	102,984	9,960	--	6,134	119,076
Percent of total	--	86.48	8.36	--	5.16	100.00

Table 8.--Area of National Forest commercial forest land by forest type and block, Yakutat Working Circle, 1957

Block	Forest Type				
	Sitka spruce (S)	Hemlock (H)	Hemlock-Sitka spruce (H-S)	Hardwoods	Total
	Acres	Acres	Acres	Acres	Acres
	Accessible				
1. Yakutat	110,950	9,800	7,200	17,400	145,350
2. Dry Bay	54,700	1,700	2,000	27,000	85,400
Total	165,650	11,500	9,200	44,400	230,750
Percent of total	71.79	4.98	3.99	19.24	100.00
	Inaccessible				
1. Yakutat	2,700	--	--	19,850	22,550
2. Dry Bay	4,600	--	--	18,500	23,100
Total	7,300	--	--	38,350	45,650
Percent of total	16.00	--	--	84.00	100.00

Table 9.--Net board foot volume of live sawtimber on National Forest commercial forest land by species and block. Yakutat Working Circle, 1957

Block	Species			Total
	Sitka spruce	Hemlock	Black cottonwood	
	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner
	Accessible			
1. Yakutat	2,905,465	588,562	97,608	3,591,635
2. Dry Bay	1,206,608	216,417	89,012	1,512,037
Total	4,112,073	804,979	186,620	5,103,672
Percent of total	80.57	15.77	3.66	100.00
	Inaccessible			
1. Yakutat	25,613	4,506	7,586	37,705
2. Dry Bay	52,602	9,192	19,579	81,373
Total	78,215	13,698	27,165	119,078
Percent of total	65.69	11.50	22.81	100.00

Table 10a.--Net volume of all timber on accessible commercial forest land by class of material and species group, combined ownership, Yakutat Working Circle, 1957

Class of Material	Total	Softwoods	Hardwoods
	Thousand cubic feet	Thousand cubic feet	Thousand cubic feet
Growing stock			
Sawtimber trees			
Sawlog portion	892,187	855,832	36,355
Upper stem portion	41,719	35,800	5,919
Total	933,906	891,632	42,274
Poletimber trees	95,515	83,536	11,979
Total growing stock	1,029,421	975,168	54,253
Other material			
Sound cull trees	456	418	38
Rotten cull trees	8,278	7,832	446
Hardwood limbs	595	--	595
Salvable dead	1,786	1,786	--
Total other material	11,115	10,036	1,079
Total, all timber	1,040,536	985,204	55,332

Table 10b.--Net volume of all timber on inaccessible commercial forest land by class of material and species group, combined ownership, Yakutat Working Circle, 1957

Class of Material	Total	Softwoods	Hardwoods
	Thousand cubic feet	Thousand cubic feet	Thousand cubic feet
Growing stock			
Sawtimber trees			
Sawlog portion	21,337	16,043	5,294
Upper stem portion	1,533	671	862
Total	22,870	16,714	6,156
Poletimber trees	3,310	1,566	1,744
Total growing stock	26,180	18,280	7,900
Other material			
Sound cull trees	13	8	5
Rotten cull trees	212	147	65
Hardwood limbs	122	--	122
Salvable dead	--	--	--
Total other material	347	155	192
Total, all timber	26,527	18,435	8,092

Table 11.--Net board foot volume of live sawtimber on commercial forest land by species and diameter class groups, combined ownerships, Yakutat Working Circle, 1957

DBH Classes	Species			Total volume by dbh classes	Percent by dbh class
	Sitka spruce	Hemlock	Cottonwood		
	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	
11.0" - 20.9"	1,077,248	360,731	156,477	1,594,456	30.48
21.0" - 30.9"	1,436,060	367,504	57,307	1,860,871	35.56
31.0" - 40.9"	1,027,354	70,055	--	1,097,409	20.98
41.0" and larger	657,155	21,860	--	679,015	12.98
Total volume by species	4,197,817	820,150	213,784	5,231,751	100.00
Percent by species	80.24	15.67	4.09	100.00	

Table 12.--Average net volume per acre in live merchantable trees on commercial forest land by land type and stand-size class, Yakutat Working Circle, 1957

Land type	Stand-size class				
	Old growth saw-timber (4)	Young growth saw-timber (3)	Pole-timber (2)	Seedlings & saplings (1)	Nonstocked (5)
Accessible					
B. F. Scribner	45,006	19,040	2,728	0	960
Cubic foot	8,375	4,488	1,439	0	248
Inaccessible					
B. F. Scribner	--	37,613	2,728	0	960
Cubic foot	--	7,572	1,439	0	248

APPENDIX

EXPLANATION OF TERMS

Land-Use Classes

Forest land.--Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than 10 percent stocking, and which has not been developed for other uses. (Forested tracts and islands of less than 10 acres and isolated strips of timber less than 120 feet wide are excluded.)

1. Commercial forest land - Forest land producing or capable of producing usable crops of industrial wood.

   a. Commercial accessible - Commercial forest land presently accessible and economically available now and which has not been withdrawn from use.

   b. Commercial inaccessible - Commercial forest land presently inaccessible and economically unavailable now and not withdrawn for specified purposes. Changing economic climate and improving logging methods probably will make portions available for development in the future.

   c. Commercial reserved - Commercial forest land withdrawn from timber utilization through statute, ordinance or administrative order. (Classed as noncommercial productive reserved by the Forest Survey).

2. Noncommercial forest land - Forest land incapable of producing usable industrial wood because of adverse site conditions and not withdrawn for specified purposes.

3. Noncommercial reserved forest land - Noncommercial forest land withdrawn for specified purposes through statute, ordinance or administrative order.

Nonforest land.--Includes land which has never supported forest growth; land from which the forest has been removed to less than 10 percent stocking and has been developed for other use, such as agricultural, residential, or industrial; all land in thickly populated urban and suburban areas; house sites; trade and manufacturing sites; lighthouse reserves; and water classified by the Bureau of the Census as land, i.e., less than 40 acres in size. Glaciers, ice fields, marsh land above mean high tide, permanent brush fields, muskegs less than 10 percent stocked to trees of any size and barren mountain tops are examples of lands which have never supported forest growth.

Forest types

Commercial forest types

Forest types are classified on the basis of the predominant species or species group that accounts for the major portion of the stand in terms of net board foot volume for sawtimber, cubic volume for poles and number of trees for seedling-sapling stands.

Sitka spruce.--Forests in which Sitka spruce is predominant.

Hemlock-Sitka spruce.--Forests in which 50 percent or more of the stand is hemlock but in which Sitka spruce makes up 30 to 49 percent of the stand.

Hemlock.--Forests predominately hemlock except when Sitka spruce comprises 30 to 49 percent of the stand.

Hardwood.--Forests predominately cottonwood or red alder, singly or in combination.

Noncommercial forest types

Scrub.--Forests characterized by open stands of stunted, limby, defective trees of no present or prospective value. All tree species may be present. Mature stands will net less than 8000 board feet per acre (Scribner rule).

1. Stands occupy swamp-like soils and contain a dense understory of blueberry and other shrubs.
2. Stands at the upper limits of tree growth.
3. Stands within the altitudinal range of merchantable timber but occupying sites too rocky and too sterile to produce merchantable timber.

Class of Timber

Sawtimber trees.--Live trees of commercial species at least 11.0-inches d.b.h. with at least 25 percent of their gross board foot volume free from rot or other defect and that contain at least one merchantable sawlog. A merchantable sawlog is not less than 16 feet long, at least 6-inches d.i.b. at the small end for softwoods and 8-inches d.i.b. for hardwoods, and which after deductions for defect contains a net scale of 33-1/3 percent. However, for any log to be merchantable it must contain at least 20 board feet (Scribner rule). Merchantable height was based on the number of 16 foot logs in softwoods to a top d.i.b. of 40 percent of d.b.h., except in the case of small trees where the minimum top is 6 inches. For hardwoods it was the number of 8 foot logs to a minimum top of 8-inches d.i.b. for small trees and 40 percent of d.b.h. for large trees.

Poletimber trees.--Live trees 5.0-inches to, but not including, 11.0-inches d.b.h. These trees are of sufficiently good form and condition to indicate that they will grow into merchantable sawtimber trees.

Seedling and sapling trees.--Live trees of commercial species less than 5.0-inches d.b.h. and of sufficiently good form and vigor to indicate that they will grow into merchantable sawtimber trees.

Cull trees.--Live trees 5.0-inches d.b.h. and over that do not qualify as sawtimber or poletimber trees due to poor form, limbiness, rot or other defect.

1. Rotten cull trees contain excessive decay.
2. Sound cull trees have excessive crook, sweep or large limbs.

Salvable dead trees.--Standing dead sawtimber-size trees containing at least one merchantable sawlog and containing at least 50 percent of the tree gross board foot volume in sound material.

Hardwood limbs.--Limbs of hardwood sawtimber trees and sawtimber-size cull hardwood trees to a minimum diameter of 4.0-inches inside bark.

Stand-size Classes

Sawtimber stands.--Forest stands in which the minimum volume for coniferous types is 8,000 net board feet (Scribner) per acre in merchantable trees 11.0-inches and larger. For hardwood sawtimber stands the minimum volume is 4,000 net board feet (Scribner) per acre.

1. Old-growth.--Sawtimber stands in which the majority of volume is in sawtimber trees more than 150 years of age.

2. Young-growth.--Sawtimber stands in which the majority of volume is in sawtimber trees less than 150 years of age.

Poletimber.--Stands failing to meet the sawtimber stand specification, but at least 10 percent stocked with poletimber and larger trees, and with at least half the minimum stocking in poletimber trees.

Seedling and sapling.--Stands not qualifying as either sawtimber or poletimber, but having at least 10 percent stocking of trees of commercial species and with at least half the minimum stocking in seedlings-and-saplings.

Nonstocked and other areas.--Commercial forest land not qualifying for any other class.

Volume Estimates

Sawtimber volume.--Net volume in board feet, Scribner rule, of that portion of live sawtimber trees between stump and the upper limit of merchantability for sawlogs. Volume deductions were made for defects and breakage. Cull factors for hemlock, spruce and cedar were obtained from Station Paper No. 6, Alaska Forest Research Center. Cull for other species and breakage were cruiser's estimates.

Cubic-foot volume:

Growing stock.--Net volume in cubic feet of live merchantable sawtimber trees and live poletimber trees of commercial species from stump to a minimum 4.0-inch top (of central stem) inside bark.

All timber volume.--Net volume in cubic feet of live poletimber trees, live and salvable dead sawtimber trees and cull trees of commercial species from stump to a minimum 4.0-inch top inside bark. Includes also the volume of all hardwood limbs to a minimum diameter of 4.0-inches inside bark.

SPECIES TALLIED 1/

The following commercial tree species were tallied in the Yakutat Timber Management Unit. Other tree species of minor importance may occur in this area, but unless they were tallied on the field plots they were not included in the following list.

Softwoods:	Sitka spruce	- Picea sitchensis
	Hemlock	
	Western hemlock	- Tsuga heterophylla
	Mountain hemlock	- Tsuga mertensiana
Hardwoods:	Black cottonwood	- Populus trichocarpa

FOREST SURVEY PROCEDURES

Area Estimate

The point sampling technique on 100 percent aerial photo coverage was used to obtain the va rious area statistics. A series of five sample plots were systematically located on each effective 1:40,000

1/ Little, Elbert L., Jr. Check list of native and naturalized trees of the United States (including Alaska). U. S. Dept. Agr., Agr. Handbook 41, 472 pp. 1953.

vertical aerial photo of the unit. The 872 plots that were established were sufficient to meet the requirements of an allowable sampling error of 3 percent of commercial forest land in terms of one standard error.

Each photo plot was then stereoscopically examined and classified as to forest or nonforest. The classification for each photo plot was determined on the basis of the 10 acre area including and immediately surrounding the plot. Plots classified as forest were then transferred to 18° oblique 1:20,000 aerial photos as this photo scale is better suited for more intensive forest examination. Next, the forest plots were classified as to commercial or noncommercial. Finally, the commercial forest plots were stratified by accessibility, forest type, stand-size and density classes. This procedure is known as stratification. The classified plots for each block were then summarized by stratum.

A sample of the plots were randomly selected and field checked. Field classifications were checked against the original photo classification for any differences in interpretation. The field check data was used to adjust the photo classification data for all of the plots in the survey unit if any differences occurred.

The detailed area data from the point samples was then expanded to the unit level. First, the known gross area of the unit was divided by the total number of photo plots to determine the number of acres represented by each. Then, the area for each stratum was a result of the product of the number of plots and the area represented by a plot.

To determine the accuracy of the office photo classification a sample of photo plots was checked in the field. A predetermined number of photos were selected at random and all of the plots on each photo, called a cluster, were examined. The number of photo clusters examined was determined by the formula: 1/

$$\left(\frac{S_{Paf}}{P_{af}}\right)^2 = \left[\frac{\sum_{i=1}^{k} N_{if}\,(1-P_{if})}{\left(\sum_{i=1}^{k} n_{if}\right)^2}\right] + \left[C^2 n'_{if} + C^2 n'_{if} - 2r(n'_{if})(n_{if})C_{n'_{if}}\,C_{n_{if}}\right]\left[\frac{k-m}{k}\right]\frac{1}{m}$$

1/ Formula recommended by Roy Chapman, statistician, Washington office.

in which:

m = number of clusters to be checked

$\frac{S_{Paf}}{P_{af}}$ = relative error of proportion in commercial forest

k = total number of photos to give complete coverage

ni = number of points examined in the i-th cluster

n_{if} = number of points classed as commercial forest land

$C_{n_{if}}$ = coefficient of variation of the n_{if}

n'_{if} = number of points examined in the field

P_{if} = proportion in commercial forest land

$C'_{n_{if}}$ = coefficient of variation of the n'_{if}

$r(n'_{if})(n_{if})$ = correlation coefficient between n_{if} and n'_{if}

Areas determined by photo-interpretation are corrected by applying a factor or ratio as determined from the comparison of photo and field classification of the random sample selected for field checking. A total of 663 photo classifications were checked in the field.

Volume Estimate

A portion of the photo plots classified as commercial forest land were randomly selected for field examination. At the field locations, survey crews collected such data as species, diameters, merchantable heights, defect, mortality, stand-size class, forest type, etc., on three plots each one-fifth acre in size at two chain intervals.

The collected data was recorded in numerical code and sent to the Data processing Unit at the Pacific Southwest Forest and Range Experiment Station. Data was compiled by IBM machines following the detailed procedures contained in "Plan for Compilation of the Alaska Forest Survey by the IBM Method". Briefly the procedure is as follows: All of the data recorded for each tree is punched on individual tree cards by location. Then the proper cull factor is applied to each tree. The trees are then sorted and data compiled by various classes such as by species, by 10-inch d.b.h. classes, by stand-size classes, by accessibility classes, etc. The tree volumes are then expanded to a per acre basis and per acre breakage factors by species applied to obtain net volume per acre. Net volumes per acre are then applied to area by classes to obtain class totals by timber management blocks.

Sufficient plots were selected at random to attain a specified level of statistical accuracy. The survey was designed for maximum efficiency in estimating total volume to meet the requirements of the Timber Management Division of Region 10 and the national survey. The allowable error for Region 10 requirement on the Yakutat inventory is 10 percent of total board foot volume.

The number of commercial forest land ground plots selected at random was determined by using the formula for stratified random sampling on a proportionate basis:

$$n = \frac{\Sigma PS_p^2}{S^2M + \frac{\Sigma PS^2_p}{N}}$$

where: n = number of sample plots

P = proportionate size of a stratum

S^2_p = preliminary estimate of variance of a population or within a stratum based on preknowledge of the stratum

S^2M = estimate of standard error of the mean of a population derived from a sample of the population

N = total number of items in the population or total number of observation

From the total required plots, samples were allocated among the strata in proportion to area. Only a token sample of the nonstocked and the seedling-sapling classes was made due to relatively high costs of field plots and low timber values presently on these areas.

A total of 57 photo plots were examined on the ground.

Sample locations examined by timber management block, Yakutat Working Circle, 1957

Block	Photo plots	Ground locations	Check plots
1. Yakutat	564	37	69
2. Dry Bay	308	20	40
Total	872	57	109

ACCURACY OF THE ESTIMATES

Errors which affect the accuracy of the area and volume estimates in this report may arise from two sources:

1. Non-sampling errors.--These are human mistakes in judgment, measurement, recording, or arithmetic. There is no practical method of finding out just how often such errors occur. These errors are kept to a minimum, however, by a diligent effort to maintain a high degree of accuracy in the collection and compilation of data and closely checking all phases of the work.

2. Sampling errors.--These errors arise from using sampling procedures rather than making a 100 percent inventory. These errors can be measured. They are the only measurable errors involved in computing the reliability of the estimates.

Accuracy of the Forest-area Estimates

Forest-land class	All ownerships Area	Sampling error
	Acres	Percent
Commercial accessible	230,950	± 5.0
Commercial inaccessible	45,650	± 11.3
Total commercial	276,600	± 4.6

The probabilities are two out of three that the actual commercial forest land area is within ± 4.6 percent of the estimated area.

The sampling error for total commercial forest land was calculated from the formula:

$$SE = \frac{\sqrt{\frac{PQ}{n}}}{P}$$

P = proportion of commercial forest land
Q = 1 - P
n = total number of photo plots

Sampling errors of National Forest commercial forest land area by timber management blocks were calculated by the formula:

$$SE_a = \frac{SE_A}{\sqrt{\frac{a}{A}}}$$

SE_a = sampling error of any block

SE_A = sampling error of total CFL of the unit

A = total area of CFL in unit

a = area of CFL in any TM block

Block	Area Sampling Error, National Forest Commercial Forest Land		
	Accessible	Inaccessible	Total CFL
	Percent	Percent	Percent
1. Yakutat	6.3	16.1	5.9
2. Dry Bay	8.2	15.8	7.3

With each subdivision of the unit total, the percentage error increases so that small acreages may have large errors and therefore indicate only relative magnitudes.

Accuracy of the Timber Volume Estimates

Commercial forest	Sawtimber	
	Volume	Sampling error
	M Bd. Ft. Scribner	Percent
Accessible	5,101,919	10.2
Inaccessible	112,944	68.6
Total	5,214,863	10.1

The probabilities are two out of three that the actual sawtimber board-foot volume is within ± 10.1 percent of the estimated total volume.

The sampling error for total volume was calculated from the formula:

$$S_M = \sqrt{\frac{\Sigma PS^2_w}{n} \times \frac{N - n}{N}}$$ where:

1. PS^2_w = weighted average variance within strata for entire area
2. N = total number of items in the population or total possible number of observations
3. n = total number of items in the sample
4. S_M = estimate of standard error of the mean of a population derived from a sample of the population

Sampling errors of volume on National Forest commercial forest land by timber management blocks were calculated from the formula:

$$SE_v = \frac{SE_V}{\sqrt{\frac{v}{V}}}$$

SE_V = sampling error of total volume
V = total volume of working circle
v = volume of any block

Block	Volume Sampling Error - Yakutat Working Circle - National Forest Commercial Forest Land		
	Accessible	Inaccessible	Total CFL
	Percent	Percent	Percent
1. Yakutat	12.2	120.1	12.1
2. Dry Bay	18.8	83.5	18.3

With each subdivision of the working Circle, the percentage error increases so that small volumes may have large sampling errors and therefore indicate only relative magnitudes.

COEFFICIENT OF VARIATION

The coefficient of variation as determined from the total sawtimber field plots examined on commercial forest land was 67 percent. This was calculated on the basis of the net board-foot volume (Scribner) of live merchantable sawtimber trees. The coefficient of variation based on cubic foot volume for poletimber stands was 56 percent.

TABLE OF SCRIBNER TO INTERNATIONAL $\frac{1}{4}$-INCH RATIOS

Species	10" - DBH Group	Ratio 1/
Western hemlock,	11.0" to 20.9"	1.16
Mountain hemlock and	21.0" to 30.9"	1.09
Sitka spruce	31.0" to 40.9"	1.05
	41.0" and larger	1.03
Hardwoods	All diameters	1.15

1/ Ratio for converting Scribner f.b. volume to International $\frac{1}{4}$-inch b.f. volume at the per acre level.

AVERAGE FORM CLASS, 16-FOOT LOG

Species	Form class
Western hemlock	82
Mountain hemlock	82
Sitka spruce	82
Hardwoods	77